The present disclosure relates to pharmaceutical compositions for inhalation comprising aclidinium in the form of a dry powder of a pharmaceutically acceptable salt in admixture with a pharmaceutically acceptable dry powder carrier, providing a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide.
NOVEL DOSAGE AND FORMULATION

[0001] This invention relates to a novel dosage for aclidinium and to novel methods and formulations for the treatment of respiratory diseases, especially asthma and chronic obstructive pulmonary disease (COPD), using aclidinium.

BACKGROUND

[0002] Aclidinium bromide is 3(R)-(2-hydroxy-2,2-dithien-2-ylacetoxyl)-1-(3-phenoxypropyl)-1-azoniabicyclo [2.2.2]octane bromide, described in, e.g., WO 01044118. Although this compound is known to be a long-acting anticholinergic useful in the treatment of respiratory diseases, the optimal dosage is not disclosed.

SUMMARY OF THE INVENTION

[0003] It is now surprisingly found that, for treatment of respiratory disorders, particularly asthma and COPD, in an adult human, aclidinium is most effective upon administration by inhalation in a dosage of about 200 micrograms per metered nominal dose, typically a single dosage of about 200 micrograms per day metered nominal dose, (e.g., about 180 micrograms emitted dose, and about 60 micrograms Fine Particle dose) (weight corresponding to aclidinium bromide).

[0004] The invention thus provides in a first embodiment a pharmaceutical composition for inhalation comprising aclidinium in the form of a dry powder of a pharmaceutically acceptable salt, e.g., aclidinium bromide, in admixture with a pharmaceutically acceptable dry powder carrier, e.g., lactose particles, (i) comprising a single metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide, or (ii) in a multidose dry powder inhaler device calibrated to provide a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide. This composition can be administered one or more times per day. Preferably once or twice a day.

[0005] In a second embodiment, the invention provides a method of treating a respiratory condition, e.g., selected from asthma and chronic obstructive pulmonary disease, in a patient in need of such treatment, comprising administering a dose, typically a single daily dose or twice daily dose, of aclidinium, e.g., aclidinium bromide, equivalent to about 200 micrograms metered nominal dose aclidinium bromide, e.g., comprising administering a pharmaceutical composition according to the previous paragraph. The invention further provides the use of aclidinium in the manufacture of a medicament, e.g., as described in the preceding paragraph, for use in such a method.

[0006] The aclidinium may be administered as monotherapy, or in combination with one or more additional anti-inflammatory and/or bronchodilating agents, e.g., corticosteroids, PDE IV inhibitors and β2-agonists, e.g., formoterol, salmeterol, budesonide, and mometasone, and the invention thus further provides methods as described above further comprising administration of an effective amount of such an agent, as well as pharmaceutical compositions as described above, further comprising such additional agent(s).

DETAILED DESCRIPTION OF THE INVENTION

[0007] Typically, the aclidinium is administered in the form of a salt with an anion X, wherein X is a pharmaceutically acceptable anion of a mono or polyvalent acid. More typically, X is an anion derived from an inorganic acid, such as hydrochloric acid, hydrobromic acid, sulphuric acid and phosphoric acid, or an organic acid such as methanesulphonic acid, acetic acid, fumaric acid, succinic acid, lactic acid, citric acid or maleic acid. Preferably the aclidinium is in the form of aclidinium bromide.

[0008] The aclidinium is preferably administered in the form of a dry powder, in admixture with a suitable carrier, e.g., lactose powder, suitable for inhalation.

[0009] For example, in one embodiment, the aclidinium is aclidinium bromide in admixture with lactose powder.

[0010] The respiratory disease or condition to be treated with the formulations and methods of the present invention is typically asthma, acute or chronic bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), bronchial hyperreactivity or rhinitis, in particular asthma or chronic obstructive pulmonary disease (COPD), especially COPD.

[0011] In the context of dosage of an active agent, “about” as used herein means within the normal limits of acceptable variations as defined by the European and US Pharmacopeia of plus/minus 35% or preferably acceptable variations as defined by the current most stringent requirement, the US FDA draft guidance for inhaler of plus/minus 25% or especially within the metered dosing accuracy for the dispensing system e.g. +/-10% Thus a metered nominal dose of “about 200 micrograms” is meant a target dose of 200 micrograms subject to variation within the normal limits of acceptance for the dispensing system, e.g. plus/minus 35% (acceptable variations as defined by the European and US Pharmacopeia) or preferably 150-250 micrograms (or acceptable variations as defined by the current most stringent requirement, the US FDA draft guidance for inhaler) or especially 170-230 micrograms (or within the metered dosing accuracy of the inhaler).

[0012] The emitted dose and the fine particle dose (fine particle dose=micrograms aclidinium bromide in the emitted dose below a cut off aerodynamic threshold of 5 micrometer) are subjected to the same variation and proportional to the metered dose and are therefore for the emitted dose e.g. a metered nominal dose of about 200 micrograms (plus/minus 35%) corresponds to about 180 micrograms emitted dose (plus/minus 35%), and about 60 micrograms Fine Particle dose (plus/minus 35%) accordingly.

[0013] Packaging of the formulation may be suitable for unit dose or multi-dose delivery. In the case of multi-dose delivery, the formulation can be pre-metered or metered in use. Dry powder inhalers are thus classified into three groups: (a) single dose, (b) multiple unit dose and (c) multi-dose device.

[0014] Formulations generally contain a powder mix for inhalation of the compounds of the invention and a suitable powder base (carrier substance) such as lactose or starch. Use of lactose is preferred. Each capsule or cartridge may generally contain between 2 µg and 400 µg of each therapeutically active ingredient. Alternatively, the active ingredient(s) may be presented without excipients.

[0015] For single dose inhalers of the first type, single doses have been weighed by the manufacturer into small containers, which are mostly hard gelatine capsules. A capsule has to be taken from a separate box or container and inserted into a receptacle area of the inhaler. Next, the capsule has to be opened or perforated with pins or cutting blades in order to allow part of the inspiratory air stream to pass through the capsule for powder entrainment or to discharge the powder from the capsule through these perforations by means of
centrifugal force during inhalation. After inhalation, the empty capsule has to be removed from the inhaler again. Mostly, disassembling of the inhaler is necessary for inserting and removing the capsule, which is an operation that can be difficult and burdensome for some patients. Other drawbacks related to the use of hard gelatine capsules for inhalation powders are (a) poor protection against moisture uptake from the ambient air, (b) problems with opening or perforation after the capsules have been exposed previously to extreme relative humidity, which causes fragmentation or indentation, and (c) possible inhalation of capsule fragments. Moreover, for a number of capsule inhalers, incomplete expulsion has been reported.

Consequently, separate disintegration means are necessary. However in practice, they are not always part of the inhaler design. Because of the high number of doses in multidose devices, powder adhesion onto the inner walls of the air conduits and the de-agglomeration means must be minimized and/or regular cleaning of these parts must be possible, without affecting the residual doses in the device. Some multi-dose inhalers have disposable drug containers that can be replaced after the prescribed number of doses has been taken (e.g., WO 97/000703). For such semi-permanent multi-dose inhalers with disposable drug containers, the requirements to prevent drug accumulation are even stricter.

In a preferred embodiment, the acidinium is administered via a breath-activated, multidose, dry powder inhaler, calibrated to permit daily dosing of 200 micrograms metered nominal dose of acidinium. An especially preferred inhaler device for this purpose is Gemair®, (formerly known as NovoAir SD2FL), or as described in WO 97/000703, WO 03/000352, or WO 03/061742, the contents of which applications are incorporated herein by reference.

Apart from applications through dry powder inhalers the compositions of the invention can be administered in aerosols which operate via propellant gases or by means of so-called atomisers or nebulizers, via which solutions or suspensions of pharmaceutically-active substances can be sprayed under high pressure so that a mist of inhalable particles results.

Medicaments for administration by inhalation desirably have a controlled particle size: The optimum particle size for inhalation into the bronchial system is usually 1-10 μm, preferably 2-5 μm. Particles having a size above 20 μm are generally too large when inhaled to reach the small airways. To achieve these particle sizes the particles of the active ingredient as produced may be size reduced by conventional means e.g. by micronisation or supercritical fluid techniques. The desired fraction may be separated out by air classification or sieving. Preferably, the particles will be crystalline.

Achieving a high dose reproducibility with micronised powders is difficult because of their poor flowability and extreme agglomeration tendency. To improve the efficiency of dry powder compositions, the particles should be large while in the inhaler, but small when discharged into the respiratory tract. Thus, an excipient, for example a mono- or polysaccharide or sugar alcohol, e.g., such as lactose, mannitol or glucose is generally employed. The particle size of the excipient will usually be much greater than the inhaled medicament within the present invention. When the excipient is lactose it will typically be present as lactose particles, preferably crystalline alpha lactose monohydrate, e.g., having an average particle size range of 20-1000 μm, preferably in the range of 90-150 μm. The median particle size approximately corresponds to the average and is the diameter where 50 mass-% of the particles have a larger equivalent diameter, and the other 50 mass-% have a smaller equivalent diameter. Hence the average particle size is generally referred to in the art as equivalent d50. The distribution of particle size around may affect flow properties, bulk density, etc. Hence to characterise a particle size diameter, other equivalent diameters can be used in addition to d50, such as d10 and d90. d10 is the equivalent diameter where 10 mass-% of the particles have a smaller diameter (and hence the remaining 90% is coarser). d90 is the equivalent diameter where 90 mass-% of the particles have a smaller diameter. In one embodiment, the lactose
Suitable lactose materials for use in the present invention are commercially available, e.g., from DMW Internacional (Respitose GR-001, Respitose SV-001, Respitose SV-003); Meggle (Capsulac 60, Inhafac 70, Capsulac 60 INH); and Boreculo Domec (Lactohale 100-200, Lactohale 200-300, and Lactohale 300-400).

The ratio between the lactose particles and the acclimim is obtained by weight and depend on the inhaler device used, but is typically, e.g., 5:1 to 200:1, for example 50:1 to 150:1, e.g., 60-70:1.

In a preferred embodiment, the acclimim is administered in the form of a dry powder formulation of acclimim bromide in admixture with lactose, in a ratio of acclimim to lactose of 1:100 to 1:150, suitable for administration via a dry powder inhaler, wherein the acclimim particles have an average particle size of from 2 to 5 μm in diameter, e.g., less than 3 μm in diameter, and the lactose particles have a d10 of 90-160 μm, a d50 of 170-270 μm, and a d90 of 290-400 μm.

Additional active agents such as β2-agonists, PDE IV inhibitors, corticosteroids, leukotriene D4 antagonists, inhibitors of cGfR-kinase, p38 kinase inhibitors or BK1 receptor agonists may be utilized in the methods and formulations of the inventions. For example, the invention provides acclimim formulations as herein further comprising an effective amount of one or more such additional active agents, e.g., further comprising an effective amount of a β2-agonist and/or a PDE IV inhibitor and/or a corticosteroid. The invention also provides methods for treating respiratory conditions as herein before described, e.g., asthma or COPD, comprising administering an acclimim formulation as described herein and further comprising administering simultaneously effective amount of one or more such additional active agents, e.g., further comprising an effective amount of a β2-agonist and/or a PDE IV inhibitor and/or a corticosteroid.

β2-agonists suitable for use with the acclimim in the present invention include, e.g., arformoterol, bambuterol, bitolterol, broxaterol, carbuterol, clenbuterol, dopexamine, fenoterol, formoterol, hexoprenaline, ibuterol, isoetharine, isoprenaline, levosalbutamol, mabuterol, meludraine, metaprotenerol, nolominicole, orciprenaline, pirbuterol, procaterol, proteruterol, ritodrine, rimoterol, salbutamol, salmefen, salmeterol, sibesdan, sotenerol, sufentaner, terbutaline, tiaramide, tolbuterol, GSK-597901, milveterol, GSK-678007, GSK-642444, GSK-159002, LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one), KUL-1248, carmoterol and indacaterol optionally in the form of their racemates, their enantiomers, their diastereomers, and mixtures thereof, and optionally their pharmacologically-compatible acid addition salts.

Since the M3 antagonists of the invention have a long duration of action, it is preferred that they are combined with long-acting β2-agonists (also known as LABAs). The combined drugs could thus be administered once or twice a day.

Particularly preferred LABAs are formoterol, or salmeterol and GSK-597901, milveterol, LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one), KUL-1248, formoterol and indacaterol optionally in the form of their racemates, their enantiomers, their diastereomers and mixtures thereof, and optionally their pharmacologically-compatible acid addition salts. More preferred are salmeterol, formoterol, LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one), and QAB-149. Still more preferred are salmeterol, formoterol and LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one), in particular salmeterol xinafoate and formoterol fumarate and LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one).

For example, the invention provides a pharmaceutical composition for inhalation comprising acclimim in the form of a dry powder of a pharmaceutically acceptable salt, e.g., bromide, in admixture with a pharmaceutically acceptable carrier, e.g., lactose particles, together with formoterol fumarate, (i) comprising a single metered nominal dose of acclimim equivalent to about 200 micrograms acclimim bromide together with a single metered nominal dose of about 5-25 micrograms (e.g., 6, 8.5, 12, 18 or 24 micrograms, for example 12 micrograms) formoterol fumarate or (ii) in a multidose dry powder inhaler device calibrated to provide a metered nominal dose of acclimim equivalent to about 200 micrograms acclimim bromide together with a metered nominal dose of about 5-25 micrograms (e.g., 6, 8.5, 12, 18, or 24 micrograms, for example 12 micrograms) formoterol fumarate.

The pharmaceutical composition for inhalation comprising acclimim and a β2-agonist, for example, formoterol or LAS100977 (5-[2-[(2, 6-difluoro-2-phenylethoxy)hexyl]amino]-1(R)-hydroxyethyl)-8-hydroxyquinolin-2(1H)-one).
yquinolin-2(1H)-one), can be administered one or more times per day. Preferably once or twice a day.

[0037] Examples of suitable PDE4 inhibitors that can be combined with aclidinium in the present invention are benafentrine dimaleate, etazolote, denbufylline, rolipram, cipamfiline, zardaverine, arofiline, filaminast, tepilukast, tofimilast picamilast, tolotaline, mesopram, drovateline hydrochloride, irilimast, roflumilast, cilomilast, ogilumast, apremilast, 6-[2-(3,4-Diethoxyphenyl)thiazol-4-yl]pyridine-2-carboxylic acid (tetomilast), (R)-[+]-4-[2-(3-Cyclopentyl-oxo-4-methoxyphenyl)-2-phenylethyl]pyridine (CDP-840), N-(3,5-Dichloro-4-pyridinyl)-2-[4-(4-fluorobenzyl)-5-hydroxy-1H-indol-3-yl]-2-oxoacetamide (GSK-842470), 9-(2-Fluorobenzyl)-N6-methyl-2-(trifluoromethyl)adenine (NCS-613), N-(3,5-Dichloro-4-pyridinyl)-8-methoxyquinoline-5-carboxamide (D-4418), N-[9-Methyl-4-oxo-1-phenyl-3,4,6,7-tetrahydroprrolo[3,2,1-ij]1,4]benzodiazepin-3(2H)-pyridine-4-carboxamide, 3-[3-(Cyclopentonyloxy)-4-methylbenzyl]-6-(ethylamino)-8-isopropyl-3H-purine hydrochloride (V-11294A), 6-[3-(N,N-Dimethylcarbamoyl) phenylsulfonfonyl]-4-(3-methoxyphenyl)-8-methyl-3H-yquinoline-4-carboxamide (GS-250666), 4,6,7-Diethoxy-2,2-bis(hydroxyethyl) naphthalen-1-yl]-1-(2-methoxyethyl)pyridin-2(1H)-one (T-4400), <trans-2-[3]-N-(2-Methylpropylcarbamoyl)-4-oxo-1,4-dihydro-1,8-naphthyridin-1-yl]-3-fluorobiphenyl-4-yl] cyclopropenecarboxylic acid (MK-8873), CDC-801, UK-500001, B2XL-914, 2-carboxymethoxy-4-cyano-4-[3-cyclopropylmethoxy-4-difluoromethoxophenyl]cyclohexan-1-one, cis-[4-cyano-4-(3-cyclopropylmethoxy-4-difluoromethoxophenyl]cyclohexan-1-one, 5(S)-[3-(Cyclopentonyloxy)-4-methoxyphenyl]-3(S)-(3-methylbenzyl)piperidin-2-one (IPL-455903), ONO-6126 (Eur Respir J 2003, 22(Suppl. 45): A32 2557) and the compounds claimed in the PCT patent application numbers WO2005/097613, WO2004/058729, WO 2005/049581, WO 2005/123693 and WO 2012/126092.

[0038] Examples of suitable corticosteroids and glucocorticoids that can be combined with aclidinium in the present invention are prednisolone, methylprednisolone, dexamethasone, dexamethasone cipicilate, rafocortic, deflazacort, halobenpredone acetate, budesonide, beclometasone dipropionate, hydrocortisone, trimcinolone acetonide, fluocinolone acetonide, fluocinonide, clocortolone pivalate, methylprednisolone acacetate, dexamethasone palmitate, tretipredone, hydrocortisone acetate, prednicarbate, alclometasone dipropionate, Buticocort propionate, RP-106541, holometasone, methylprednisolone sulphonate, metomestone furoate, rimexolone, prednisolone famesylate, ciclesonide, depredone propionate, fluticasone propionate, fluticasone furoate, halobetasol propionate, loratredanol etabonate, betametasone butyrate propionate, flunisolide, prednisone, dexamethasone sodium phosphate, trimcinolone, betametasone 17-valerate, betametasone, betametasone dipropionate, 21-Chloro-11beta-hydroxy-17alpha-[2-(methylsulfonyl)acetoyl]-3-pregnene-3,20-dione, Desisobutryl-ciclesonide, hydrocortisone acetate, hydrocortisone sodium succinate, NS-126, prednisolone sodium phosphate, hydrocortisone probutate prednisolone sodium metasulfolbenzoate and clobetasol propionate, especially budesonide or mometasone.

[0039] For example, the invention provides a pharmaceutical composition for inhalation comprising aclidinium in the form of a dry powder of a pharmaceutically acceptable salt, e.g., bromide, in admixture with a pharmaceutically acceptable carrier, e.g., lactose particles, together with mometasone furoate, (i) comprising a single metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide together with a single metered nominal dose of about 100-900 µg (e.g. 100, 110, 200, 220, 300, 330, 400, 440, 800 or 880 µg, for example 200-450 µg, e.g. 220 or 440 µg) mometasone furoate, or (ii) in a multidose dry powder inhaler device calibrated to provide a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide together with a metered nominal dose of about 100-900 µg (e.g. 100, 110, 200, 220, 300, 330, 400, 440, 800 or 880 µg, for example 200-450 µg, e.g. 220 or 440 µg) mometasone furoate.

[0040] The pharmaceutical composition for inhalation comprising aclidinium and a corticosteroid, for example mometasone furoate, can be administered one or more times per day. Preferably once or twice a day.

[0041] The invention also provides a pharmaceutical composition comprising aclidinium, a β2-agonist as defined above and a corticosteroid, as defined above. Most preferred β2-agonists are selected from LASS100977 ((5S)-2-[(6S,2S,2S)]difluoro-2-phenylethoxy)hexylaminol]-1(R)-hydroxyethyl]-8-hydroxyquinolin-2(1H)-one and formoterol. Most preferred corticosteroid is a mometasone furoate. These triple combinations are suitable for administration once or twice a day.

EXAMPLE 1

[0042] Methods: Patients with moderate to severe stable COPD were randomized to receive double-blind, once-daily treatment with aclidinium (25, 50, 100, 200, or 400 µg), placebo, or open-label tiotropium 18 µg for 4 weeks. Spirometric measurements were performed at 22-24 h after the first dose and then at weekly intervals, and from 0.5-6 h postadministration on Day 1 and at Week 4 (Day 29).

[0043] Results: The ITT population included 460 patients. Aclidinium dose-dependently increased trough FEV1 on Day 29 (table).

Mean change from baseline in trough FEV1 on Day 29

<table>
<thead>
<tr>
<th>Aclidinium (dose-blind)</th>
<th>Tiotropium (open-label)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 µg</td>
<td>50 µg</td>
</tr>
<tr>
<td>n</td>
<td>65</td>
</tr>
<tr>
<td>Mean Δ, ml</td>
<td>39</td>
</tr>
</tbody>
</table>

*p < 0.05 vs placebo.

[0044] Unlike tiotropium, the bronchodilatory effect of aclidinium during the first 6 h post-dose on Day 29 was comparable to that on Day 1 (all doses). Time to peak FEV1 was achieved at 3 h post-dose for aclidinium 100-400 µg. Aclidinium was well tolerated, with no-dose-dependent effect on ECG, laboratory parameters or adverse events.

[0045] Conclusion: Aclidinium produced sustained bronchodilation over 24 h and was well tolerated. Aclidinium 200 and 400 µg had comparable bronchodilatory effects to open-label tiotropium 18 µg. Based on the efficacy and tolerability data, aclidinium 200 µg was selected as the investigational dose for a future long-term clinical trial in COPD.
1. A pharmaceutical composition comprising aclidinium in the form of a dry powder of a pharmaceutically acceptable salt in admixture with a pharmaceutically acceptable dry powder carrier, wherein the pharmaceutical composition is capable of providing a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide, wherein the pharmaceutical composition is for inhalation.

2. The pharmaceutical composition according to claim 1, in the form of a single-dose dry powder formulation comprising a single metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide.

3. The pharmaceutical composition according to claim 1, in the form of a multi-dose dry powder formulation for administration in a multidose dry powder inhaler device calibrated to provide a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide.

4. The pharmaceutical composition according to claim 1, wherein the pharmaceutically acceptable salt of aclidinium is aclidinium bromide.

5. The pharmaceutical composition according to claim 1, wherein the pharmaceutically acceptable carrier is lactose particles.

6. The pharmaceutical composition according to claim 1, wherein the ratio aclidinium to carrier ranges from 1:50 to 1:150 by weight.

7. The pharmaceutical composition according to claim 6, wherein the ratio of aclidinium to carrier ranges from 1:100 to 1:150 by weight.

8. The pharmaceutical composition according to claim 1, wherein the average particle diameter of aclidinium ranges from 2 μm to 5 μm.

9. The pharmaceutical composition according to claim 1, wherein the carrier comprises particles having a d10 ranging from 90 μm to 160 μm, a d50 ranging from 170 μm to 270 μm, and d90 ranging from 290 μm to 400 μm.

10. The pharmaceutical composition according to claim 1, further comprising an effective amount of at least one additional active agent chosen from β2-agonists, PDE IV inhibitors, and corticosteroids.

11. The pharmaceutical composition according to claim 10, wherein the at least one additional active agent is chosen from formoterol, salmeterol, budesonide, and mometasone, wherein the at least one additional active agent is in free or pharmaceutically acceptable salt form.

12. The pharmaceutical composition according to claim 11, wherein the at least one additional active agent is formoterol fumarate in an amount ranging from about 5 micrograms to 25 micrograms per metered nominal dose.

13. The pharmaceutical composition according to claim 11, wherein the at least one additional active agent is mometasone furoate in an amount ranging from about 100 micrograms to 900 micrograms per metered nominal dose.

14. A method of treating a respiratory condition chosen from asthma and chronic obstructive pulmonary disease, comprising administering a dose of aclidinium equivalent to about 200 micrograms metered nominal dose of aclidinium bromide by inhalation to a patient in need of such treatment.

15. (canceled)

16. The method of claim 14, comprising administering a pharmaceutical composition comprising aclidinium in the form of a dry powder of a pharmaceutically acceptable salt in admixture with a pharmaceutically acceptable dry powder carrier, wherein the pharmaceutical composition is administered in a metered nominal dose of aclidinium equivalent to about 200 micrograms aclidinium bromide.

17. The method of claim 16, further comprising administering an effective amount of at least one additional active agent chosen from β2-agonists, PDE IV inhibitors, and corticosteroids.

18. The method of claim 17, wherein the at least one additional active agent is chosen from formoterol, salmeterol, budesonide, and mometasone in free or pharmaceutically acceptable salt form.

19. The method according to claim 18, wherein the at least one additional active agent is formoterol fumarate in an amount ranging from about 5 micrograms to 25 micrograms per metered nominal dose.

20. The method according to claim 18, wherein the at least one additional active agent is mometasone furoate in an amount ranging from about 100 micrograms to 900 micrograms per metered nominal dose.

21-25. (canceled)

26. A multidose dry powder inhaler device calibrated to deliver, upon actuation, a metered nominal dose of aclidinium equivalent to about 200 micrograms of aclidinium bromide.

27. The method of claim 14, wherein the dose is chosen from a single-daily dose and a twice-daily dose of aclidinium equivalent to about 200 micrograms metered nominal dose of aclidinium bromide.

28. The method of claim 27, wherein the dose is chosen from a single-daily dose of aclidinium equivalent to about 200 micrograms metered nominal dose of aclidinium bromide.

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